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AUTHOR Mangels, Kenneth
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ABSTRACT

This paper presents the results of a comparison of data from the Lutheran Church-Missouri Synod (LCMS) 4th (n=179) and 8th (n=143) grade student and teacher samples to the data from the 1990 National Assessment of Educational Progress (NAEP) 4th and 8th grade student and teacher samples. This is part of a larger study of mathematics education in the LCMS that seeks to determine the overall effectiveness of its parochial school system's mathematics education. The sample was randomly selected from the LCMS school system student population. Consistency between LCMS and NAEP samples was determined on a percentage basis for each question. Student attitudes towards mathematics and the amount of student time spent on mathematics homework (4th grade) were found to be consistent between LCMS and NAEP. Inconsistencies were found in the amount of mathematics instructional time, the amount of student time spent on mathematics homework (8th grade), the use of calculators and computers in the mathematics classroom, and the mathematical activities occurring in the mathematics classroom (textbooks, worksheets, group vs. individual work, test-taking, reports, projects, and manipulatives). Other similar studies between public and private schools are recommended. (Contains 14 references.) (JAF)

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# A STUDY OF MATHEMATICS EDUCATION IN THE LUTHERAN CHURCH-MISSOURI SYNOD SCHOOLS USING BACKGROUND QUESTIONS FROM THE 1990 NATIONAL ASSESSMENT OF EDUCATIONAL PROGRESS

**Kenneth Mangels**
**Christ College, Irvine, CA**

**Paper Presented at the 1993 Annual Meeting of the American Educational Research Association**
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# A STUDY OF MATHEMATICS EDUCATION IN THE LUTHERAN CHURCH-MISSOURI SYNOD SCHOOLS USING BACKGROUND QUESTIONS FROM THE 1990 NATIONAL ASSESSMENT OF EDUCATIONAL PROGRESS

**Kenneth Mangels, Christ College, Irvine, CA**

## *Introduction*

As part of a larger study of mathematics education in The Lutheran Church-Missouri Synod (LCMS) elementary and middle schools, data concerning the pedagogical milieu were collected through the use of a questionnaire that was structured after the 1990 NAEP Background and Mathematics questions for students and teachers (Mangels, 1992). This paper presents the results from the comparison of data from The LCMS 4th and 8th grade student and teacher samples to the data from the 1990 NAEP 4th and 8th grade student and teacher samples. The purpose of the comparison was determine if any consistencies existed between the results of the two studies. (National Center for Educational Statistics [NCES], 1991).

## *Background and Existing Research*

National assessments of the American educational system, and in particular mathematics education, have been conducted periodically during the last twenty years. Most prominent are the National Assessment of Educational Progress (NAEP) and the International Assessment of Educational Progress (IAEP). These two assessments, along with other traditional standardized tests have painted a deteriorating image of our nation's students' mathematics abilities and lend support to the belief that America's schools, in general, are not doing an adequate job in educating our youth. These indictments against the nation's school systems appear to implicate all institutions of education, both public and nonpublic. However, only 8% of students in the 1988 NAEP and IAEP assessments were enrolled in nonpublic schools (NAEP, 1987). While these results certainly indicate problems within the educational system, they do not provide enough evidence to thoroughly evaluate the performance of nonpublic schools. Research has shown that public and nonpublic schools are not alike; yet, little research has occurred which

deals specifically with the assessment of mathematics education in the nonpublic schools.(Lee & Stewart, 1989; Hannaway & Abramowitz, 1985; Kraushaar, 1972)

Private and parochial elementary schools educate 11.6% of the nation's children, and one such significant subgroup of the nonpublic school system is The Lutheran Church-Missouri Synod (LCMS) elementary and middle schools (NCES, 1989). Today, these LCMS schools form the largest Protestant school system in the United States (Board for Parish Services, 1989). Hence, an examination of mathematics education in this particular parochial system is appropriate in the overall process of evaluating mathematics education in the United States. Donovan and Madaus in their article in Research on Exemplary Schools (1985) encourage this comparative-type research for studying achievement in the academic disciplines such as mathematics.

## *Methods and Data Source*

For the analysis of the classroom activities, samples of 179 fourth grade students and 143 eighth grade students were randomly selected from the participating LCMS schools. The students completed a questionnaire with the same questions from the instruments used in the 1990 NAEP assessment. Collected data included the frequency with which certain instructional activities, such as the students' use of textbooks, worksheets, manipulatives, small group activities, calculators and computers occurred during their mathematics classes. Similarly, samples of 44 fourth grade teachers and 37 eighth grade teachers were selected from The LCMS elementary and middle schools and asked to complete a questionnaire using the questions from the 1990 NAEP teacher background questionnaire. Like the students, the teachers were asked the frequency with which certain instructional activities occurred in their classrooms as well as pertinent questions about their mathematics curriculum.

Consistency between the NAEP and The LCMS studies was determined by comparing the NAEP percentages to the corresponding LCMS percentage for each question. If the NAEP percentages of responses were within one standard error of their corresponding LCMS

percentages, then those responses were considered consistent. If a majority of the responses for a given hypothesis were found to be consistent, then the results from the two studies were considered consistent by definition. For this paper, the calculated standard errors of the percentage responses will be included in parentheses.

## *Results*

**The attitudes of students towards mathematics was found to be consistent with the findings from the background questionnaires in the 1990 NAEP study.**

The students in both the NAEP and LCMS studies were asked identical attitudinal questions about mathematics; that is, Do they like mathematics? Are they good in mathematics? Is Mathematics useful in solving everyday problems? and Do people use mathematics in their jobs? The LCMS students were consistent with their national peers in their attitudes towards mathematics, as the majority of the NAEP percentages of sample responses were within one standard error of the corresponding LCMS sample percentages. In response to the statement, "I like mathematics," 67%(0.8) of the NAEP fourth graders and 65%(3.3) of The LCMS fourth graders indicated they agreed with the statement. These two scores were considered consistent since 67% was within one standard error of The LCMS percentage. In addition, the majority of the fourth grade students from both studies agreed that they were good in mathematics, that mathematics was useful for solving problems, and that mathematics was used by most people in their everyday jobs.

In the eighth grade, the student results were also found to be consistent between the two studies. However, the results from both studies did suggest more eighth graders than fourth graders were either undecided, disagreed, or strongly disagreed over whether or not they liked mathematics. Also, the data showed more NAEP and LCMS fourth graders than eight graders were either ambivalent or disagreed with the statements regarding the usefulness of mathematics in a person's job skills.

**The amount of mathematics instructional time in The LCMS classrooms was found to be inconsistent with the findings from the background questionnaires in the 1990 NAEP study.**

The fourth grade data revealed that given a choice of three time intervals, 0 to 30 minutes, 31- 45 minutes or 46 or more minutes; 61%(4.8) of The LCMS teachers reported they allotted approximately 31 to 45 minutes for mathematics. By contrast, 65%(1.7) of the teachers from the NAEP sample reported their mathematics classes were 46 or more minutes in length.

Differences were also apparent between the two studies regarding the length of mathematics instruction in the eighth grade. Sixty percent (5.5) of The LCMS teachers agreed with their fourth grade colleagues that most mathematics classes lasted between 31 to 45 minutes. By contrast, the NAEP teachers' percentage of responses were almost equally spread across the three time intervals.

**The amount of student time spent on mathematics homework in The LCMS schools was found to be consistent with the fourth grade student NAEP findings, but inconsistent with the fourth grade teacher, the eighth grade teacher, and the eighth grade student NAEP findings from the background questionnaires in the 1990 NAEP study.**

Only two out of the five NAEP teacher percentage responses summarized were found consistent with The LCMS results and one of them was questionable due to the insufficient size of the LCMS teachers' samples. Forty-nine percent (2.3) of the NAEP and 48%(4.9) of The LCMS teachers indicated they assigned 15 minutes of daily homework. The greater proportion of the remaining fourth grade teachers from the two studies reported they assigned 30 minutes of homework.

Fourth grade students, in responding to the amount of daily homework they were assigned in mathematics, showed a strong consistency between the two studies in the three time choices of 15 minutes, 30 minutes, and 45 minutes. These consistent results supported the fourth grade teachers' data whereby the greater proportion of the fourth graders in both studies received either 15 or 30 minutes of daily homework.

Results from the eighth grade teachers were mixed. Only one time period was found to be consistent between the two studies, and this result was questionable due to insufficient sample

size. However, one trend in the eighth grade data was apparent. The LCMS teachers appeared to assign more homework than those teachers in the NAEP sample. Seventy-six percent(4.8) of The LCMS eighth grade teachers reported assigning 30 minutes of daily homework compared to only 45%(2.8) of the NAEP teachers. The majority of the other eighth grade teachers in both studies indicated they assigned 15 minutes of homework.

According to the eighth grade students, three of the five time allotments were found to be consistent between the NAEP and LCMS studies. Thirty-two percent(1.2 NAEP, 3.5 LCMS) of the eighth graders from both studies reported 15 minutes of homework. In addition, 32%(0.7) of the NAEP students and 30%(3.5) of The LCMS students indicated they received 30 minutes of daily homework. Confirming what the NAEP and LCMS fourth graders data showed, most of the eighth grade students also stated they were assigned between 15 and 30 minutes of mathematics homework on a daily basis. Hence, the eighth grade student data from the two studies did not support the teachers' data which had suggested that LCMS eighth grade teachers assigned more homework than their national counterparts.

**The use of calculators and computers in The LCMS mathematics classrooms was found to be inconsistent with the findings from the background questionnaires in the 1990 NAEP study.**

Both teachers and students were questioned on the use of calculators and computers in mathematics. To determine consistency between the studies, the calculator and computer data were analyzed separately and according to the teacher and student data.

Use of Calculators. According to the teachers' data, the two studies were consistent regarding calculator accessibility in the fourth grade. Forty-one percent(4.8) of The LCMS teachers reported having school-owned calculators available for their students, while 44%(2.5) of the NAEP teachers indicated they had calculators available for their fourth graders. However, in the eighth grade, calculators appeared to be more accessible to the NAEP students than The LCMS students. Fifty-two percent(3.5) of the NAEP eighth grade teachers indicated school-

owned calculators were available for their students while only 32%(5.2) of The LCMS teachers reported likewise.

The NAEP and LCMS teachers' data across both grade levels were also consistent in their findings regarding unrestricted use of calculators in mathematics. Only 19%(2.2) of the NAEP eighth grade teachers and 16%(4.1) of The LCMS teachers indicated they allowed students to have unrestricted use of calculators. In the fourth grade, under 5% of the teachers in both studies allowed such unlimited use.

According to the teachers' data, the two studies were found to be very consistent in results describing calculator usage in the fourth grade. In both the NAEP and The LCMS studies, fourth grade teachers reported their students' use of calculators was infrequent during mathematics. On one end of the Likert scale, under 10% of the fourth grade teachers in both studies reported student use of calculators was several times a week, while at the other end, 50%(4.9) of The LCMS teachers and 47%(2.5) of the NAEP fourth grade teachers indicated their students never used calculators.

Calculator usage appeared to be more prevalent in the eighth grade classrooms, especially within The LCMS sample. Fifty-one percent (5.6) of The LCMS teachers reported students used their calculators at least several times a week, compared to only 30%(3.0) in the NAEP sample. However, a conservative approach to the use of calculators was also evident at this grade level as a relatively high percentage of the NAEP and LCMS eighth grade teachers also indicated their student use of calculators was either never, or weekly or less.

The NAEP and LCMS teachers reported school-owned calculators were more accessible in the NAEP sample, especially within the eighth grade. In both studies, however, calculator use by students during mathematics class appeared to be very limited in the fourth grade. More frequent student use was reported by the eighth grade teachers, especially in The LCMS sample.

The LCMS and NAEP fourth and eighth grade students' data showed some consistent results between the two studies on the use of calculators in mathematics. Both the fourth and eighth graders from the NAEP and LCMS studies indicated about 30% of them used their calculators

either on a weekly basis or less. Lack of calculator use was most apparent and consistent in the fourth grade with 62%(1.9) of the NAEP students and 66%(3.3) of The LCMS students claiming no use of calculators during mathematics instruction.

The student data were in agreement with their teachers by also showing that a greater frequency of calculator usage occurred during eighth grade mathematics. This was especially true in The LCMS sample. Fifty-eight percent (3.8) of The LCMS eighth graders indicated calculators were used several times a week while only 30%(1.9) of the eighth graders in the NAEP sample indicated similar usage.

Other student findings between the two studies found a consistent percentage of eighth grade students using calculators to complete mathematics problems at home. In addition, the eighth grade students from both studies concurred on the restricted use of calculators during tests or quizzes. Approximately one-third of the NAEP and LCMS eighth grade students reported they were not allowed to use calculators during testing.

**Use of Computers**. According to the teachers' data, computers were found to be available to most of the teachers in both studies. In the fourth grade, only 19%(2.1) of the NAEP teachers and 18%(3.9) of The LCMS teachers, and correspondingly in the eighth grade, only 27%(3.0) of the NAEP teachers and 19%(4.1) of The LCMS teachers reported having no computers available to them. However, a relatively high percentage of teachers also indicated their computers were difficult to access for classroom instruction.

For those fourth grade students who had access to computers, the findings from the two studies showed consistent results regarding the time allotments for student use of computers. Approximately 30% of the fourth grade teachers in both studies reported their students spent, on the average, 15 minutes per week on the computer.

According to the NAEP and LCMS teachers' data, computer usage was more frequent in the fourth grade than in the eighth grade. Consistent results from the two studies showed approximately half of the fourth grade teachers from both studies reported their students worked on a computer at least once a week. In the eighth grade, 13%(2.4) of the NAEP teachers and

22%(4.6) in The LCMS study reported at least weekly use. In addition, both studies were consistent in reporting computers were used infrequently (i.e., less than once a week or never) by the eighth grade students during mathematics. Fifty-two percent (2.8) of the NAEP eighth grade teachers and 47%(5.6) of The LCMS teachers stated their students never used computers for their mathematics classes. Additionally, 35%(3.4) of the NAEP eighth grade teachers and 31%(5.2) of The LCMS teachers reported student use of computers was less than once a week.

In general, the student findings agreed with the teachers' results. However, the student data did suggest computers were used less frequently at both grade levels during mathematics classes than their corresponding teachers had reported. Additionally, a high percentage of NAEP and LCMS fourth and eighth grade students reported they had never used the computer during class.

In sum, the results on calculator and computer usage during mathematics classes were mixed with both studies, especially as reported by the students, showed their usage to be limited across both grade levels.

**The mathematical activities occurring in LCMS mathematics classrooms was found to be inconsistent with the findings from the background questionnaires in the 1990 NAEP study.**

An integral aspect of this study was to analyze the working milieu of mathematics teachers in The LCMS elementary and middle schools and those schools who participated in the NAEP study. To determine this, the data were analyzed for consistency according to four areas: use of mathematics textbooks and worksheets; types of classroom mathematics activities; instructional emphasis placed on mathematical content areas; and instructional emphasis placed on particular mathematics skills.

**Use of Mathematics Textbooks and Worksheets**. The teachers' data showed few consistent results between the two studies. However, a high percentage of the teachers and students from both studies reported almost daily use of their textbook as a source of problems during mathematics. Across both grade levels, The LCMS teachers reported a greater reliance upon the textbook than those in the NAEP sample. Both The LCMS teachers and students reported that

73% of fourth grade students and approximately 86% of The LCMS eighth grade students daily solved problems from their textbooks. By comparison, in the NAEP study, 64%(2.4) of the fourth grade teachers and 71%(2.2) of the eighth grade teachers indicated daily use of their mathematics textbooks when solving problems. Similarly, the fourth and eighth grade students from the NAEP sample also agreed with their teachers and reported approximately the same percentages. Consequently, in both studies, the fourth and eighth grade teachers and students showed a heavy reliance upon the textbook as a daily source of problems.

Both the teacher and the student data from the two studies showed that worksheets were used frequently during mathematics classes. This was especially evident in the consistent findings between the NAEP and LCMS fourth grade students: 57% of the fourth graders in both studies used worksheets at least several times per week; about 23% of the NAEP and LCMS fourth graders used them once a week, and approximately 20% of these same students reported their use of worksheets was less than weekly.

Students from both studies reported considerably less reliance upon worksheets in the eighth grade, especially in The LCMS sample. Sixty-five percent (3.6) of The LCMS eighth grade students, compared with 37%(1.9) of the NAEP students, stated they used worksheets less than weekly.

The teachers' data from both studies also showed worksheets were used frequently during mathematics classes. Similar to the student data, the eighth grade teachers from both studies indicated less reliance upon worksheets than their fourth grade colleagues. However, the majority of the NAEP and The LCMS teachers reported using worksheets at least several times a week or about once a week.

Mathematics Activities in the Classroom. To determine consistency between the data, the NAEP and LCMS samples were analyzed with respect to student participation in four areas: small group activities, use of manipulatives, test-taking, and writing reports and/or projects.

*Use of small group activities.* In the teachers' data in Table 1, no consistent findings were found in grade four. However, the data did indicate the NAEP fourth grade teachers used small group activities more frequently than their LCMS counterparts.

Table 1

Teachers' and Students' Reports on the Use of Small Group Activities in Mathematics Classrooms

**Teachers' Report**

| | At least once a week | | Less than once a week | | Never | |
|---|---|---|---|---|---|---|
| | NAEP% | LCMS% | NAEP% | LCMS% | NAEP% | LCMS% |
| Work in small groups | | | | | | |
| Grade 4 | 63(2.5) | 36(4.7) | 32(2.5) | 61(4.8)[a] | 5(0.8) | 2(1.4)[b] |
| Grade 8 | 49(3.0) | 54(5.5)[a] | 41(2.9) | 43(5.5)[a] | 11(1.7) | 3(1.9)[b] |

**Students' Report**

| | At least once a week | | Less than once a week | | Never | |
|---|---|---|---|---|---|---|
| | NAEP% | LCMS% | NAEP% | LCMS% | NAEP% | LCMS% |
| Work in small groups | | | | | | |
| Grade 4 | 33(1.3) | 31(3.2)[a] | 23(0.8) | 30(3.2)[a] | 44(1.4) | 39(3.4) |
| Grade 8 | 28(1.9) | 35(3.6) | 27(1.0) | 25(3.3)[a] | 45(2.1) | 40(3.7) |

Note. Standard errors of the percentages are in parentheses. Population percentages may not total 100% due to rounding.

[a] NAEP percent lies within one standard error of The LCMS percentage.

Most of the fourth grade teachers in both studies incorporated the use of small groups into their mathematics classes at some time, since less than 6% of them reported never using any type

of small group activities. The fourth grade students' results from both studies were not in agreement with their respective teachers. The students reported less use of small group activities during mathematics classes. The NAEP and LCMS fourth grade student data showed about one-third of them worked at least once a week in small groups. In addition, 44%(1.4) of the NAEP fourth graders and 39%(3.4) of The LCMS fourth graders indicated they never participated in small group activities.

Likewise, the NAEP and LCMS eighth grade student data in Table 1 were not in agreement with their respective teachers over the frequency of small group activities during mathematics. About 50% of the eighth grade teachers from both studies reported the use of small group activities at least once a week, compared to only 28%(1.9) of the NAEP eighth graders and 35%(3.6) of The LCMS eighth graders who reported at least weekly use. In addition, while less than 12% of the eighth grade teachers from both studies stated they never used small group activities during mathematics, 40%(3.7) and 45%(2.1) of The LCMS and NAEP eighth grade students, respectively, reported not participating in any type of small group activities.

The NAEP teacher data in Table 1 also showed a decline in the at-least-once-a-week use of small group activities from fourth grade to eighth grade--63%(2.5) to 49%(3.0). However, in The LCMS study, just the opposite was found. According to The LCMS teachers, 36%(4.7) of the fourth graders participated in some form of small group activities at least once a week, increasing to 54%(5.5) in the eighth grade.

*Use of Manipulatives*. According to the teacher data recorded in Table 2, manipulatives appeared to be used more frequently by those teachers in the NAEP sample. Forty-nine percent (2.2) of the NAEP fourth grade teachers indicated manipulatives were used at least once a week compared to 30%(4.5) of The LCMS teachers. In the eighth grade, the differences between the two studies were not as great with 28%(3.0) of the eighth grade teachers in the NAEP sample indicating at least weekly use and 19%(4.4) in The LCMS sample. In addition, both the NAEP

Table 2

Teachers' and Students' Reports on the Use of Manipulatives in Mathematics Classrooms

**Teachers' Report**

| | At least once a week | | Less than once a week | | Never | |
|---|---|---|---|---|---|---|
| | NAEP% | LCMS% | NAEP% | LCMS% | NAEP% | LCMS% |
| Work with manipulatives and/or objects like rulers, geometric shapes, etc. | | | | | | |
| Grade 4 | 49(2.2) | 30(4.5) | 50(2.3) | 68(4.9) | 1(0.4) | 2(1.4)[a,b] |
| Grade 8 | 28(3.0) | 19(4.4) | 64(3.3) | 78(4.6) | 8(1.2) | 3(1.9)[b] |

**Students' Report**

| | NAEP% | LCMS% | NAEP% | LCMS% | NAEP% | LCMS% |
|---|---|---|---|---|---|---|
| Work with manipulatives and/or objects like rulers, geometric shapes, etc. | | | | | | |
| Grade 4 | 43(1.1) | 43(3.4)[a] | 27(0.7) | 41(3.4) | 30(1.1) | 16(2.5) |
| Grade 8 | 30(1.4) | 25(3.3) | 31(0.7) | 40(3.7) | 39(1.5) | 36(3.6)[a] |

Note. Standard errors of the percentages are in parentheses. Population percentages may not total 100% due to rounding.

[a] NAEP percent lies within one standard error of The LCMS percentage.

[b] Standard error unreliable due to insufficient sample size.

and LCMS teachers agreed manipulatives appeared to be used more frequently in the fourth grade.

The students' data in table 2, however, were not in total agreement with the teachers' results. For example, the student results suggested a greater percentage of the NAEP and LCMS students reported less use of manipulatives than their respective teachers. This appeared to be

especially true in the eighth grade with 39%(1.5) of the NAEP students and 36% of The LCMS students indicating they had never used manipulatives in mathematics class. The teachers' data reported 8%(1.2) of the NAEP eighth graders and 3%(1.9) of The LCMS eighth graders did not use manipulatives in their classes. In general, the student and teacher results from both studies indicated the majority of fourth and eighth graders used manipulatives less than once a week.

*Test-Taking.* The teachers' results showed 48% of the fourth grade students and 60% of the eighth grade students in the NAEP study were assessed with teacher-generated tests at least once a week. Only 23%(4.3) of LCMS fourth and eighth grade teachers used teacher generated tests this often. Both studies were consistent in reporting 52% of the NAEP and LCMS fourth grade teachers tested less than once a week. Twenty-five percent (4.2) of The LCMS fourth grade teachers and 17% (4.2) of The LCMS eighth grade teachers indicated they never used teacher-generated tests. Other types of published tests were also reportedly used by the majority of the fourth and eighth grade teachers in both studies, but these were administered less than once a week.

In the fourth grade, 52%(2.3) of the NAEP students reported they were tested at least once a week with 34%(3.3) of The LCMS students indicating similar weekly testing. Seventy-one percent of the NAEP eighth grade students were tested at least once a week compared to 37%(3.7) of The LCMS eighth grade students. Hence, according to the students, the NAEP teachers tested more frequently than their LCMS counterparts.

*Writing Reports and/or Projects.* Very few eighth grade students, nationwide or in The LCMS sample, were asked to write a report or to do a mathematics project. The LCMS teachers reported fewer LCMS eighth grade students participated in these types of activities than did students in the NAEP study. Eighty percent (4.5) of The LCMS teachers said their students were never assigned reports or projects. Correspondingly, 43%(3.1) of the teachers surveyed in the NAEP study indicated the absence of such assignments. However, the students from the two studies reported just the opposite. Fifty-six percent (3.8) of The LCMS students reported they never did written reports or projects, and 70%(1.0) of the eighth graders surveyed in the NAEP

assessment reported likewise. Nevertheless, from either perspective, the results of the two studies showed a high percentage of the eighth grade students who never had to write reports or do projects in mathematics.

**Instructional Emphasis Placed on Mathematics Content Areas.** The curricular data collected in the NAEP assessment and The LCMS study were analyzed for consistency by grade level. The NAEP and LCMS fourth grade teachers' data in Table 3 were consistent with respect to curricular emphasis they placed on whole number operations and common fractions. Eighty-six percent (1.3) of the NAEP teachers and 88%(3.2) of The LCMS teachers placed heavy emphasis upon whole number operations. In addition, a consistent percentage of fourth grade teachers in the two studies placed either heavy or moderate emphasis on the teaching of common fractions.

Additionally, the NAEP and LCMS fourth grade teachers' data in Table 3 showed the majority of teachers reported either heavy or moderate emphasis was given to other traditional fourth grade mathematics topics such as common fractions and measurement. A consistently high proportion of both NAEP and LCMS fourth grade teachers gave little or no emphasis to topics such as decimal fractions and probability and statistics. In addition, most of the fourth grade teachers from both studies indicated little or no emphasis was given to the teaching of algebra concepts. Likewise, geometry and the teaching of probability and statistics were given a low teaching priority by both groups of fourth grade teachers. Fifty-five percent (4.9) of The LCMS teachers and 39%(2.6) of the NAEP teachers indicated little or no instructional emphasis in geometry, and 79%(4.0) of The LCMS teachers and 75%(1.9) of the NAEP teachers reported little or no emphasis placed on the teaching of probability and statistics. The instruction of whole number operations was also quite prevalent in the eighth grade, but even more apparent within The LCMS sample. In Table 3, 83%(10.2) of The LCMS eighth grade teachers, compared to 64%(4.7) in the NAEP study, reported placing either a heavy or moderate emphasis in whole number operations. The traditional topics usually covered in the eighth grade -- percents, common and decimal fractions, measurement, ratio and proportion, and

Table 3

Teachers' Reports on Instructional

Emphasis Placed on Content Areas

| | Heavy Emphasis | | Moderate Emphasis | | Little or No Emphasis | |
|---|---|---|---|---|---|---|
| | NAEP% | LCMS% | NAEP% | LCMS% | NAEP% | LCMS% |
| Whole number operations | | | | | | |
| Grade 4 | 86(1.3) | 88(3.2)[a] | 13(1.3) | 12(3.2)[a] | 1(0.4) | 0 |
| Grade 8 | 34(2.3) | 23(4.7) | 30(2.4) | 60(5.5) | 35(2.3) | 17(2.0) |
| Common Fractions | | | | | | |
| Grade 4 | 17(1.8) | 21(4.0)[a] | 60(2.6) | 63(4.7)[a] | 23(2.0) | 16(3.6) |
| Grade 8 | 49(2.5) | 34(5.3) | 37(2.3) | 57(5.5) | 14(1.3) | 9(3.2)[b] |
| Decimal Fractions | | | | | | |
| Grade 4 | 7(1.1) | 5(2.1)[a,b] | 39(1.9) | 35(4.7) | 55(2.1) | 56(4.9)[a] |
| Grade 8 | 48(2.8) | 31(5.2) | 39(2.3) | 46(5.6) | 13(1.5) | 23(4.5) |
| Ratio & Proportion | | | | | | |
| Grade 8 | 39(2.6) | 46(5.6) | 48(2.2) | 49(5.6)[a] | 12(1.5) | 6(2.7)[b] |
| Percents | | | | | | |
| Grade 8 | 49(3.0) | 51(5.6)[a] | 42(2.7) | 49(5.6) | 9(1.3) | 0 |
| Measurement | | | | | | |
| Grade 4 | 18(2.0) | 9(2.6)[b] | 67(2.3) | 54(4.9) | 15(2.0) | 37(4.7) |
| Grade 8 | 17(1.7) | 9(3.2)[b] | 50(2.6) | 54(5.6)[a] | 33(2.5) | 37(5.4)[a] |
| Geometry | | | | | | |
| Grade 4 | 8(1.1) | 5(2.1)[b] | 53(2.6) | 41(4.8) | 39(2.6) | 55(4.9) |
| Grade 8 | 27(2.2) | 17(4.2) | 49(2.5) | 60(5.5) | 23(2.4) | 23(4.7)[a] |

**(table continues)**

| | Heavy Emphasis | | Moderate Emphasis | | Little or No Emphasis | |
|---|---|---|---|---|---|---|
| | NAEP% | LCMS% | NAEP% | LCMS% | NAEP% | LCMS% |
| Tables or Graphs | | | | | | |
| Grade 4 | 27(1.9) | 9(2.8)[b] | 60(2.2) | 54(4.9) | 12(1.5) | 37(4.7) |
| Grade 8 | 13(1.5) | 11(3.5)[a,b] | 57(2.4) | 54(5.6)[a] | 30(2.6) | 34(5.3)[a] |
| Probability/Statistics | | | | | | |
| Grade 4 | 2(0.6) | 5(2.1)[b] | 23(1.7) | 14(3.4) | 75(1.9) | 79(4.0)[a] |
| Grade 8 | 9(1.4) | 3(1.9)[b] | 35(2.5) | 26(4.9) | 57(2.8) | 71(5.1) |
| Algebra | | | | | | |
| Grade 4 | 16(1.7)[c] | 5(2.1)[b] | 16(1.7)[c] | 21(4.0) | 84(N/A) | 74(4.3) |
| Grade 8 | 50(2.1) | 54(5.6)[a] | 33(2.1) | 37(5.4)[a] | 17(1.8) | 6(2.7)[b] |

Note. Standard errors of the percentages are in parentheses. Population percentages may not total 100% due to rounding.

[a] NAEP percent lies within one standard error of The LCMS percentage.

[b] Standard error unreliable due to insufficient sample size.

[c] This percentage and standard error, 16(1.7), includes those teachers in the NAEP study who marked either heavy or moderate emphasis.

algebra concepts -- were given heavy or moderate emphasis by the majority of both the NAEP and The LCMS eighth grade teachers.

Consistent findings between the NAEP and LCMS eighth grade teachers were found in the content areas of measurement, tables or graphs, and algebra. In Table 3, the eighth grade teachers were in agreement on the status of algebra in the eighth grade curriculum. Fifty percent (2.1) of the NAEP teachers and 54%(5.6) of The LCMS teachers indicated algebra was heavily emphasized in their classes, while 33%(2.1) of the NAEP teachers and 37%(5.4) of The LCMS teachers gave it only moderate emphasis. A consistent majority of the eighth grade teachers from both studies placed a moderate emphasis upon the topics of measurement, and tables or graphs.

Moreover, the results also showed a consistent one-third of the NAEP and LCMS teachers reportedly gave little or no emphasis to the instruction of measurement, and tables or graphs, and 57%(2.8) of the NAEP teachers and 71% of The LCMS teachers gave little or no emphasis to the teaching of probability and statistics.

The results of this section varied with both studies showing some consistencies and inconsistencies between the data. However, the results were beneficial in describing the instructional environments within the two studies.

**Instructional Emphasis Placed on Particular Mathematical Skills**. Teachers in both studies were asked to report the amount of emphasis they placed on four particular learning skills. The first two dealt with the learning of facts, concepts and procedures. The last two focused on the students' development of communication skills and higher-level thinking abilities.

From both studies, the data showed consistent results with respect to the first mathematical skill. In the fourth grade, 91%(1.4) of the NAEP teachers and 88%(3.2) of The LCMS teachers gave heavy emphasis to the teaching of Learning Facts and Concepts. Likewise, a consistent percentage of the fourth grade teachers also reported giving this same mathematical skill moderate emphasis. In addition, although not consistent, over 75% of the fourth grade teachers from both studies gave heavy emphasis to the second mathematical skill -- Learning Skills and Procedures.

In the eighth grade, over half of the teachers from both studies gave heavy emphasis to the teaching of the first two mathematical skills. In addition, almost all of the NAEP and LCMS fourth grade teachers and over 90% of the eighth grade teachers from both studies indicated they placed either a heavy or moderate emphasis on those same two mathematics skills.

In response to the third and fourth skills, slightly over 40% of the NAEP fourth and eighth grade teachers stated they placed a heavy emphasis on the skill of Learning to Develop Reasoning and Analytic Abilities and just under 40% of the NAEP fourth and eighth grade teachers placed a heavy emphasis on the skill of Learning How to Communicate Ideas

Effectively. However, in The LCMS sample 19%(3.8) and 26%(4.9) of the fourth and eighth grade teachers, respectively, indicated these skills were given a heavy emphasis in their teaching. The majority of NAEP and LCMS teachers placed a heavy to moderate emphasis on thinking and communication skills. However, in The LCMS fourth grade, nearly 30%(4.4) of the teachers indicated little or no emphasis was given to the teaching of analytical thinking and communication skills in mathematics. In general, a greater percentage of the fourth and eighth grade teachers from both studies placed a heavy emphasis upon the teaching of learning facts, concepts, skills and procedures than the last two skills which dealt with developing analytical thinking abilities and communication skills.

## ***Discussion***

It was not unexpected that mathematics education in The Lutheran elementary and middle schools was found to be both similar and different than their national counterparts in the teaching of mathematics. Therefore, of more interest, was the identification of what were the actual similarities and differences.

The students from both studies appear to be similar in their attitudes towards mathematics and it uses in everyday life. From the teachers perspective, LMCS fourth grade students were given the same amount of homework as fourth grade students nationwide, but LCMS eighth graders were given more daily work. The LCMS student findings, on the other hand, indicated that both fourth and eighth grade students were assigned more homework than those from the NAEP study. Given the emphasis on the use of today's technology, it was interesting to note that both studies found most fourth and eighth grade mathematics teachers had computers available to them; however, many of these same teachers also indicated a problem of accessibility for instruction. Both studies also found that computer use was greater in the fourth grade than in the eighth grade. The accessibility of calculators, however, was found to be greater in the NAEP samples across both grade levels. It also appears that calculators are used more frequently in the eighth grade than in the fourth grade, especially within the LCMS

samples. Regarding both computers and calculators, it was apparent that both studies found their usage in mathematics classes to be limited across both grade levels.

While fourth and eighth teachers across the nation and in The LCMS schools reported a high reliance upon their mathematical textbooks for instructional problems, it was even more apparent within the LCMS samples. Worksheets were found to be used regularly in both the NAEP and LCMS fourth grade samples, while in the eighth grade students reported less use, especially within The LCMS sample.

Conflicting reports were given across grade levels regarding the use of small group activities in mathematics. In the NAEP study, small group activities occurred more often in the fourth grade classrooms than in the eighth grade. However, in The LCMS study, just the opposite was true with LCMS eighth graders reporting more experiences with small group activities. In addition, The LCMS and NAEP teachers and students were not in agreement over the frequency of small group activities in mathematics. While the NAEP and LCMS fourth and eighth grade teachers reported frequent use of small group activities during mathematics instruction, the fourth and eighth grade students from both studies reported limited experiences with small group activities.

Similar to this study's findings on small group activities, The LCMS and NAEP fourth and eighth grade teachers reported a greater use of manipulatives than did the students. However, in general, both studies showed manipulatives were used infrequently during mathematics instruction. Manipulatives appeared to be used more often in the NAEP and LCMS fourth grade samples.

Teachers and students from both studies agreed few eighth grade students were expected to complete a project or some form of written assignment in mathematics. Periodical testing was found to be quite frequent in mathematics, more so in the NAEP samples.

In both studies and across both grade levels, the data confirmed that learning mathematical facts, concepts and procedures were still given a high priority in the

mathematics curriculum. In addition, the study of whole numbers and whole number operations dominated the curriculum, especially in The LCMS samples. More fourth and eighth grade NAEP teachers than LCMS teachers reported placing a higher priority on the importance of teaching analytical thinking and communication skills in mathematics.

This study is considered a beginning of a longitudinal study in mathematics education for The LCMS elementary and middle schools. Replication of this study is encouraged to map the progress The Lutheran schools will be making towards the recommended NCTM standards. Likewise, similar studies need to continue whereby public and other nonpublic educational systems and their curriculum are being systematically evaluated and compared with the nation's schools at large. Comparisons and constructive criticisms of the public and nonpublic schools are needed in the continuing improvement process of education. If changes are to occur, it is imperative that these changes be made prior to entering the 21st century. Hence, ongoing assessments and evaluations of these pedagogical changes need to occur periodically in both the public and nonpublic schools as a monitoring process to validate their progress.

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